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Department of the Interior
Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 29

July, August and September 1959



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CONTENTS

Plastic Film Cutoff and Canal Lining
Land Corner Monuments
Dog Catcher
Automatic Weed Rack
Underwater Inspection Scope
Control of Algae and Black Fly Attachment to Concrete Flumes
Aluminum Markers for Transmission Towers
Spreader Box on Dozer Blade
New Compressor Adapted to Truck Mounting
One-man Ditcher
Concrete Bonding Agents
Base Plate for Current Meter Rod
Split-ring Collar Supports Operating Shaft
Clearing Floating Logs from Reservoirs

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A plastic cutoff curtain is placed in a trench
on the lower bank of a canal on the Boise Proj-
ect, Idaho, to reduce seepage losses. P3-D-16092

OPERATION AND MAINTENANCE
EQUIPMENT AND PROCEDURES

Release No. 29

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INTRODUCTION

A long needed and requested item is being forwarded with this issue--a subject index for the bulletin. It is stapled to the outside of the back cover so that it can be easily detached. The articles in this issue, Release No. 29, have been included in the index. It is contemplated that the index will be brought up-to-date and issued once each year with the second quarter release.

This bulletin, published quarterly, is circulated for the benefit of irrigation project operation and maintenance people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. Reference to a trade name does not constitute the endorsement of a particular product, and omission of any commercially available item does not imply discrimination against any manufacturer. It is hoped that the labor-saving devices and less costly equipment developed by the resourceful water users will be a step toward commercial development of equipment for use on irrigation projects in a continued effort to reduce costs and increase operating efficiency.

To assure proper recognition to those individuals whose suggestions are published in this and subsequent bulletins, the suggestion number as well as the person's name is being given. All Bureau offices are reminded to notify their Suggestions Awards Committee when a suggestion is adopted.

* * * * *

Division of Irrigation Operations
Commissioner's Office
Denver, Colorado

PLASTIC FILM CUTOFF AND CANAL LINING

Two experimental installations of plastic film were made under the Bureau's Lower-cost Canal Lining Program this past spring (1959) as a part of the evaluation of plastics for such purposes. In one installation, as shown on the cover of this issue of the bulletin, the film was installed as a cutoff curtain in a trench excavated on the inside of the downhill bank of the canal prism. In the other installation, as shown below, the film was placed as a buried membrane.



Cutoff Curtain Installation

The "C" East Canal of the Payette Division of the Boise Project

at the site of installation, is located on the side of a low hill, as shown at left, where the subgrade material generally is a sandy loam, but consists in some reaches largely of fine and coarse clean sands overlying a relatively impervious clay layer located approximately 14 feet below the bottom of the canal. High seepage through this section fostered the growth of willows



and tules below the canal and contributed to the general water-logging of adjacent irrigated farm lands.

The canal was originally designed with a 16-foot bottom width, a 6.95-foot normal water depth, and $1\frac{1}{2}$:1 side slopes. Considerable excavation would have been required to remove the existing subgrade material to provide a side slope of $2\frac{1}{2}$:1 on the upper bank, which is presently recommended, had buried membrane type canal lining been utilized for seepage control in this reach. For this reason, the decision was made to construct a nearly vertical cutoff barrier, as shown in the drawing on the facing page. The figure illustrates the work involved, showing the relative dimensions of the excavated trench, the location of the plastic curtain, etc. Field investigations indicated that it was approximately 28 feet from a point 18 inches above the normal water level in the canal to the top of the clay layer underlying the section.

Project forces constructed benches on the lower side of the canal with bulldozers, as shown in the photograph on the preceding page.

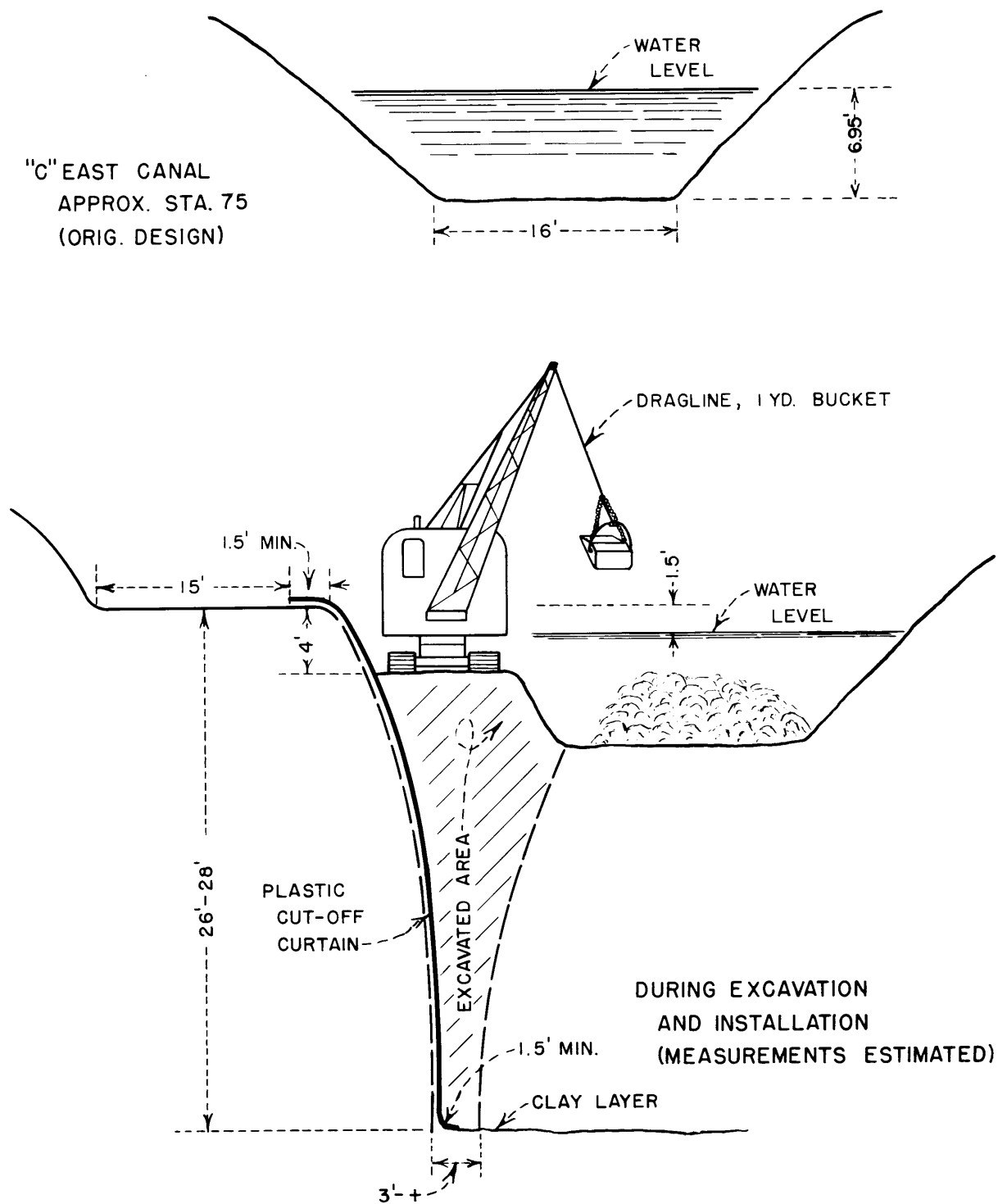


The top of the bench was 18 inches vertically above the operating water level of the canal and was used as the working level for a dragline with a 1-cubic yard bucket, as shown at left. The cutoff trench varied from 26 to 28 feet in depth, with the slope of the upper portion being about $1\frac{1}{2}$:1, while the bottom portion was practically vertical.

Several samples of plastic materials were submitted to the Bureau's Engineering Laboratories in Denver, Colorado, for initial evaluation well ahead of the field installation. The most promising of these samples was selected by the manufacturer for the field trials from the test results supplied. Selected for the cutoff curtain was an 8-mil thick vinyl plastic. This material, prefabricated into a single sheet 30 feet wide and 400 feet long, was shipped to the site of the work in a wooden crate measuring 4 feet in width, 8 feet in length, and 2 feet in depth. A sample of the plastic used is attached below.

The plastic had been folded, using an accordion type fold 4 feet wide. In order to reduce the tension that would be inflicted upon the material in unfolding and spreading the 400-foot long single

"C" EAST CANAL
APPROX. STA. 75
(ORIG. DESIGN)



LOWER COST CANAL LINING PROGRAM (REGION I)
EXPERIMENTAL PLASTIC CUT-OFF CURTAIN INSTALLATION
BLACK CANYON IRRIGATION DISTRICT
NOTUS, IDAHO

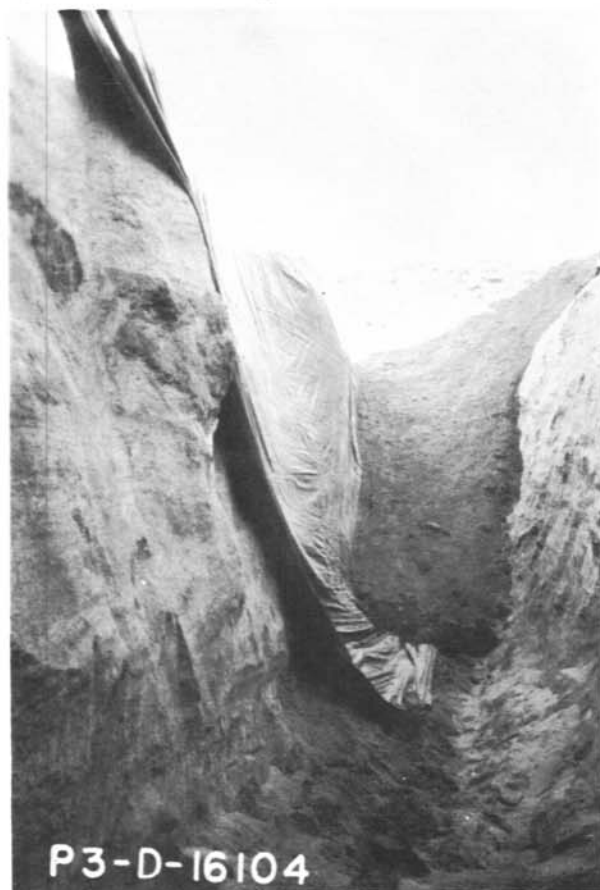
FIGURE 3

sheet of plastic, it was decided to place the film near the center of the



installation and unfold about one-half of the material upstream from that point first; later unfolding the remaining 200 feet in the downstream direction. Accordingly, after about half of the excavation had been completed, the film was spread on the upstream reach, as shown at left, by 8 men in a simple and rapid operation. It was then lowered into the trench gradually, until ap-

proximately $1\frac{1}{2}$ feet of the sheet remained at the bench level. This allowed for ample material in the bottom of the trench on the clay layer.



To minimize the possibility of water getting under the plastic, a shallow trench about 1-foot wide and 1-foot deep was cut into the bottom and side of the trench, and the curtain was securely anchored in the trench.

Close examination failed to reveal any tears or rips due to the unfolding or placement; however, some of the nailheads used in the fabrication of the shipping crate punctured the material in transit and these had to be repaired on the job. This was accomplished effectively and simply with a liquid adhesive applied to the surface of the plastic and application of a patch of the vinyl material.

In order to determine if the 8-mil thick material was strong enough to resist puncturing or tearing when placed over a rough subgrade, lower photograph above, the material was very closely observed during the backfilling operation, which was accomplished with a bulldozer. In

areas where there was undercutting which tended to stretch the plastic during backfilling, slack was provided as necessary by lowering the material slightly from the berm. It was then anchored at the berm with a hand placed layer of loose earth.

There was no evidence of punctures or tears, indicating that a plastic material with a relatively high tensile strength can be used over a rough subgrade without injury, providing the backfilling operation is carefully done and the backfill material does not contain sharp rocks or cobbles.



The previously stockpiled material from the trench excavation on the uphill side of the canal was gradually dozed into the trench.

After the trench was completely filled, the cover for the film on the lower bank was worked up the slope, as shown in the upper photograph.

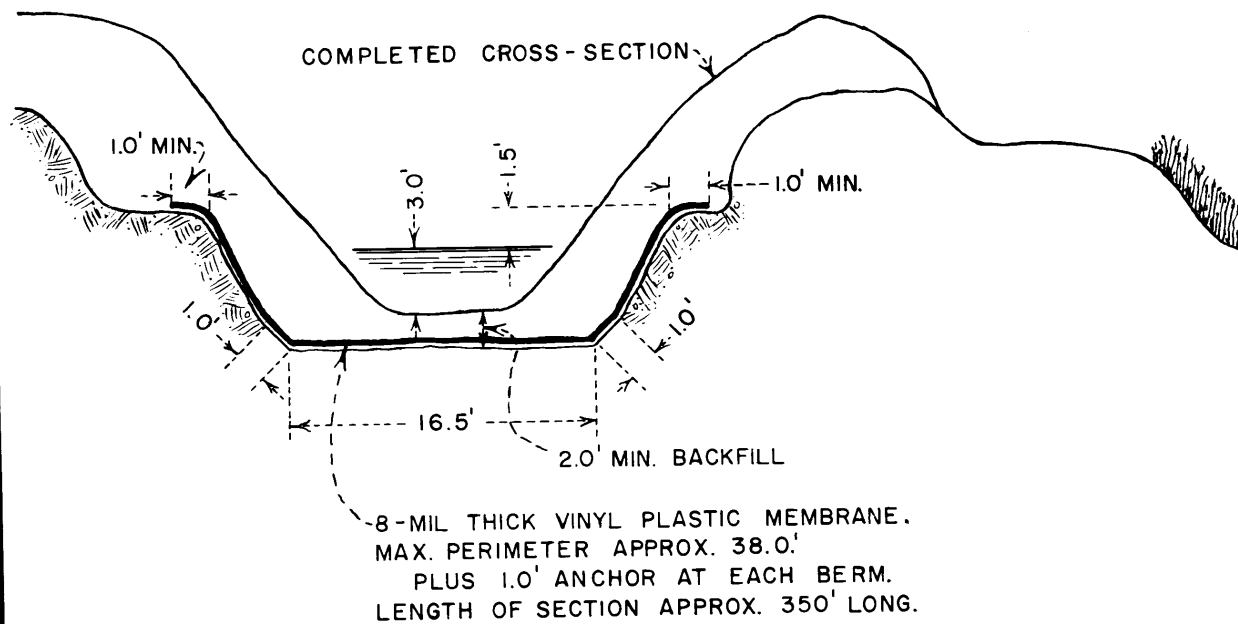
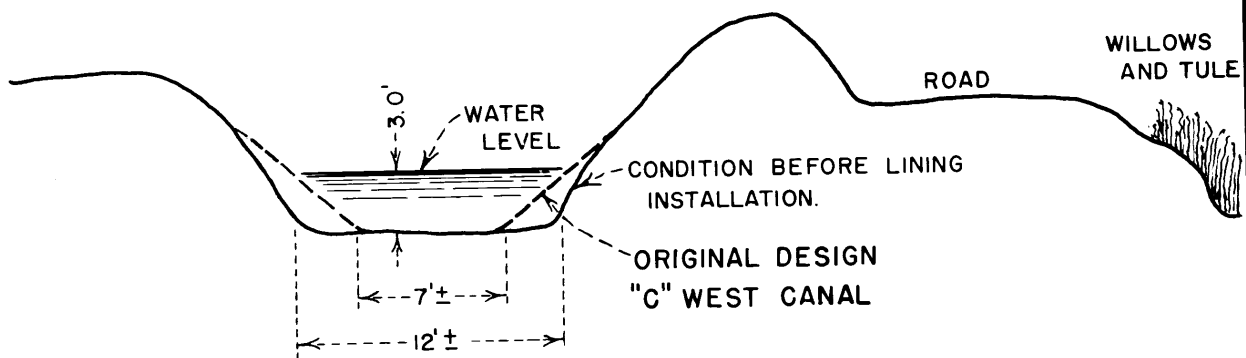


The entire job was accomplished in the period March 30, 1959, when excavation was started, through April 4, 1959, when the canal was placed in operation as shown in the lower photograph. It would seem the plastic has possibilities in emergency repairs

of a canal during the operating season, as well as providing a more permanent cutoff of seepage losses.

Buried Membrane Lining Installation

The experimental buried plastic canal lining also was placed on the Payette Division of the Boise Project in the "C" West Canal. This canal had a bottom width of 7 feet, side slopes of $1\frac{1}{2}$:1, and the normal operating water depth is 3 feet. The figure on the following page illustrates the method used in placing the lining in a 350-foot long reach of the canal.



LOWER COST CANAL LINING PROGRAM (REGION I)
EXPERIMENTAL BURIED PLASTIC MEMBRANE INSTALLATION
BLACK CANYON IRRIGATION DISTRICT
NOTUS, IDAHO

FIGURE 5



A similar method of benching used in the cutoff curtain installation was employed for the buried lining installation as shown at left. The benches, about 10 feet wide, were leveled by dozers 18 inches in elevation above maximum water elevation in the canal, allowing ample free-board. A dragline excavated the invert 2 feet below normal canal grade.

Cutoff trenches were provided at both ends of the reach to be lined, and the 8-mil thick vinyl plastic, identical to that used in the cutoff curtain installation, was placed over the canal perimeter, tucking the film into the cutoff trenches. It was held in place at the berm by hand placement of loose earth. This installation required a single sheet of the film that was 40 feet in width and 350 feet long.

The slopes of the canal were left essentially as excavated with the dragline. That is, no special trimming or rolling was performed although one pass with a motor patrol or grader, had there been one available having the mold board angled to trim the slope, would have produced a much better subgrade or base for the plastic at practically no cost. The sequence of operations is shown in the photographs below and on the following pages.



The plastic film, after removal from the shipping crate, was placed near the center of the reach to be lined and methods similar to that used in placing and handling the film for the cutoff curtain were followed. Since the installation was in a curved reach of the canal, some folding of the film was necessary on the inside of the curve.

The lining material was placed rapidly and without difficulty, as shown below, with the air temperature at 34 to 35 degrees F. and with the wind velocity up to 15 miles per hour.



It should be pointed out, as will be evident from the photographs, that the side slopes as excavated for the lining were approximately $1\frac{1}{2}:1$ in lieu of the $2\frac{1}{2}:1$ slopes used in previous installations of this kind. This was done purposely to reduce the amount of excavation necessary on the hillside location. One obvious advantage of placing the material over steeper side slopes is that the plastic membrane is buried far deeper at the toe of the slope than in the usual buried membrane installation, and therefore, less likely to become damaged during future cleaning operations with necessary heavy cleaning equipment.



Material excavated from the canal was used to cover the plastic membrane. Placement of the cover was accomplished by both drag-

line and dozer. In the lower photograph the cover material is being deposited on the membrane in the bottom of the canal. The cover on the bottom was spread to a minimum thickness of 2 feet. Side slopes were then replaced to the original $1\frac{1}{2}:1$, as shown in the photograph on the following page.

The buried membrane installation also was accomplished with a minimum of difficulty and in an entirely satisfactory manner as described. Cost of the 8-mil thick vinyl plastic, prefabricated and delivered at the site was estimated to be about \$0.35 per square yard, although materials for both installations were donated for the work by the manufacturer which



among other manufacturers who have also furnished plastic materials for other installations, is experimenting with the development of products suitable for both exposed and buried plastic lining materials.

Several suggestions were made for improvement of packaging. It was suggested that a heavy cardboard carton would be preferable to the wooden crate, providing the plastic material is not too heavy or bulky. This was recommended to avoid damage and puncture of the film in packing, in transit, and in unpacking. If the heavy material or large piece of material is to be required, and a wooden crate must be used, a heavy cardboard or other suitable lining should be provided inside the wooden crate with special care given to the fastenings on the crate. It was also suggested that the plastic be folded each way from the center and also accordion folded from each end toward the center to facilitate unfolding in the area in which the lining is to be placed.

Mr. William B. Kays, the manufacturer's representative who assisted in the installation, recommends the use of an acrylic adhesive, if available, for patching the film.

The installations were cooperative efforts. The University of Idaho, located at Moscow, Idaho, and represented by Mr. Dave Hendricks, of the University Engineering Experiment Station, performed the preliminary field studies, under agreement with the Bureau of Reclamation. The preliminary work included coring and logging the materials in the field and measurement of seepage losses from the canal reaches. The University will, as part of a general cooperative agreement, continue to evaluate the installation over the next several years.

Arrangements for and the general coordination of the work was the responsibility of Mr. Homer Graham, the Bureau's representative on

the Lower-cost Canal Lining Committee in Region 1. Mr. John V. Walker, Project Manager, Black Canyon Irrigation District, with headquarters at Notus, Idaho, provided the necessary labor and equipment for the installations and generally supervised the work. Mr. William B. Kays represented the manufacturer and Mr. L. M. Ellsperman represented the Commissioner's Office, Denver, in the installation, and supplied the information and illustrations for this article.

* * * * *

LAND CORNER MONUMENTS (Suggestion R2-59-58)

Preserving land corner markers is a problem in most cultivated areas and is no less a problem on the Klamath Project in northern California and southern Oregon, constructed by the Bureau of Reclamation, major portions of which are now operated by several water user organizations. A method of overcoming the problem is that of burying the land corner monuments.

This, of course, introduces a second problem --that of locating the buried marker.



Burt Mitchell of the Klamath Project has suggested a method of burial and location that can eliminate the problems. He points out that land corner monuments can be buried in a capped pipe sleeve in cultivated areas to protect the marker from damage by farming operations; and that the buried monument can then be located by use of an aquameter, a device used in locating buried pipe lines.

The pipe, pipe cap and the bench-mark type monument are shown in the photograph above.

Mr. Mitchell holds an aquameter, which quickly locates buried markers.

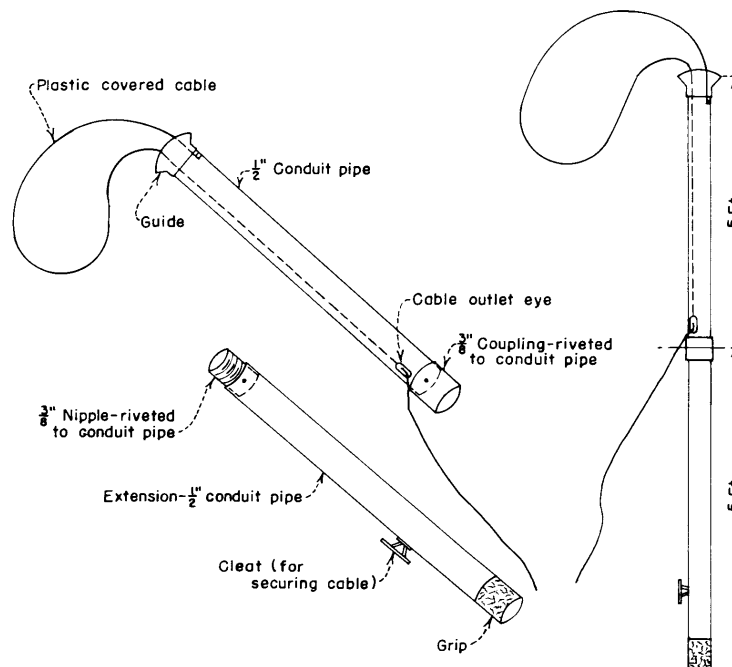
* * * * *

DOG CATCHER (Suggestion R2-59-161)

A device for removing dogs or other small animals from canals is shown in the sketch below. The device was the suggestion of Donald J. Berry, Supervisory Engineering Technician, Tracy Operations Field Branch, Central Valley Project, California. The suggestion enables a ditchrider to remove animals from the water without the danger of being bitten.

In the operation of the concrete-lined Contra Costa Canal with its steep slopes of $1\frac{1}{4}:1$, it becomes the ditchrider's duty to rescue small animals which either accidentally fall or deliberately jump into the water. They cannot escape from the canal because of the steep banks. Dogs are the most common animals that become trapped in this way. Previously a rope noose was used to extricate the animals, but this often took many tries, depending upon the skill of the ditchrider, before the animal could be caught. After the animal was pulled onto the canal bank the rescuer was exposed to attack by the frightened animal, especially when an attempt was made to remove the noose.

The device suggested is now in regular use along the Contra Costa Canal System. The two 5-foot sections are threaded together for use, fashioning the loop in the plastic covered cable. In extricating an animal the loop is placed around the animal's midsection and the cable is drawn tight, securing the excess cable to the cleat provided on the handle of the device. Upon removal, the cable can be quickly released.



* * * * *

AUTOMATIC WEED RACK

"The Kennewick Division of the Yakima Project (Washington) probably has about the same floating debris problems that all of you have experienced," stated Mr. Van E. Nutley, Manager of the Kennewick Irrigation District, which operates and maintains the irrigation facilities recently completed by the Bureau of Reclamation. "Corrective devices include, among others, the usual canal fence weed traps and many sloping-pipe weed racks . . . However, the most troublesome spot on the canal is a siphon entrance which is also the entrance to a direct connected turbine pump."

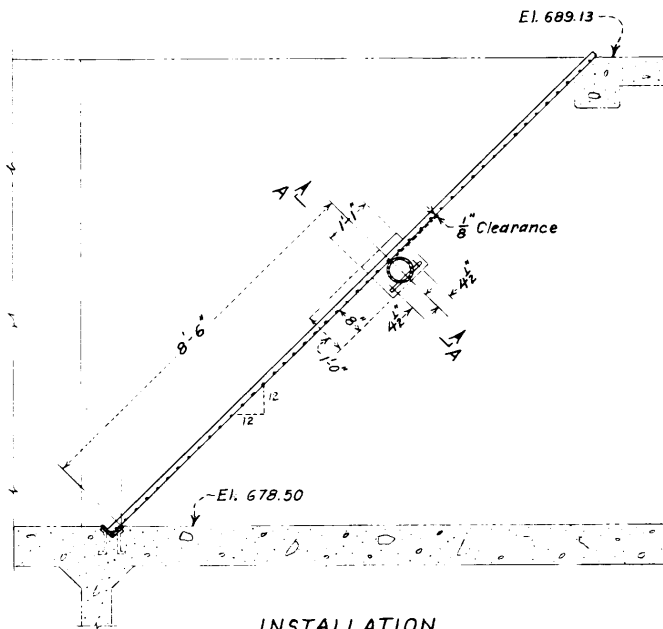
"The Amon siphon and pump entrance, at mile 25, which takes all the main canal water (243 cfs), came equipped with a trash rack set on a 1:1 slope, with one-inch openings. With this rack absolutely clean, the average velocity through the one-inch slots approaches 5 feet per second. Nobody has to tell you what a little running algae; a few dead fish, and a 25-mile wind, to bring tumble weeds into the canal, will do to this structure."

Mr. Nutley was discussing the weed removal problems encountered in his operation of the irrigation system, at an Irrigation Operator's Conference in Boise, Idaho, February 18 and 19, 1959, and the installation of an automatic weed rack is shown in the photograph below.

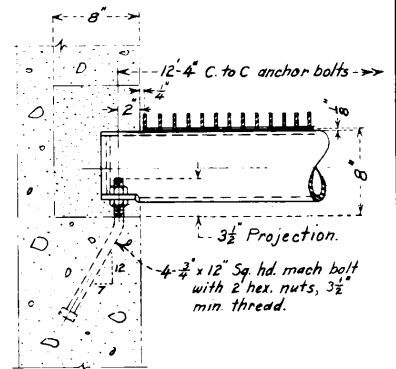


Angle-iron bars moving upward by sprocket-driven endless chains, carry weeds to a conveyor which in turn carry the weeds to a pit which is provided to trap and burn the weeds.

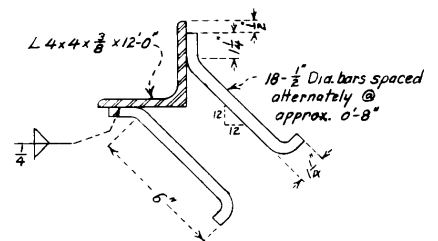
The most troublesome spot to which Mr. Nutley referred was provided with a trashrack as shown on the following page during original



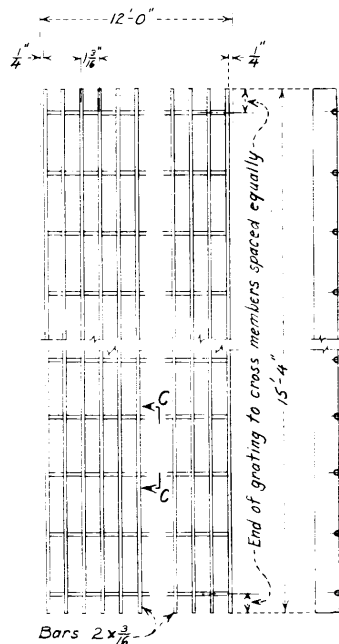
INSTALLATION



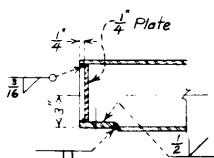
SECTION A-A



TRASHRACK SEAT
STRUCTURAL STEEL
ONE REQUIRED



TRASHRACK
STEEL-GALVANIZED
ONE REQUIRED

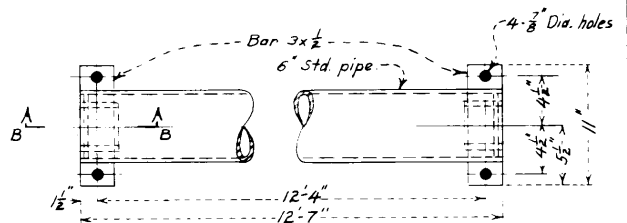


SECTION B-B

Cross members shall be not less than 1/8 square inch in cross sectional area.



SECTION C-C



TRASHRACK SUPPORT
STEEL
ONE REQUIRED

NOTES

Grating panels shall be Type I welded steel galvanized grating conforming with Federal Specifications RR-6-661a and with bearing bar sizes and spacing as shown on this drawing.
Number of panels making up the overall width of trashrack to be determined by the contractor, but no panel to be less than 12 inches wide.
Total estimated weight..... 2,900 lbs.

REFERENCE DRAWING

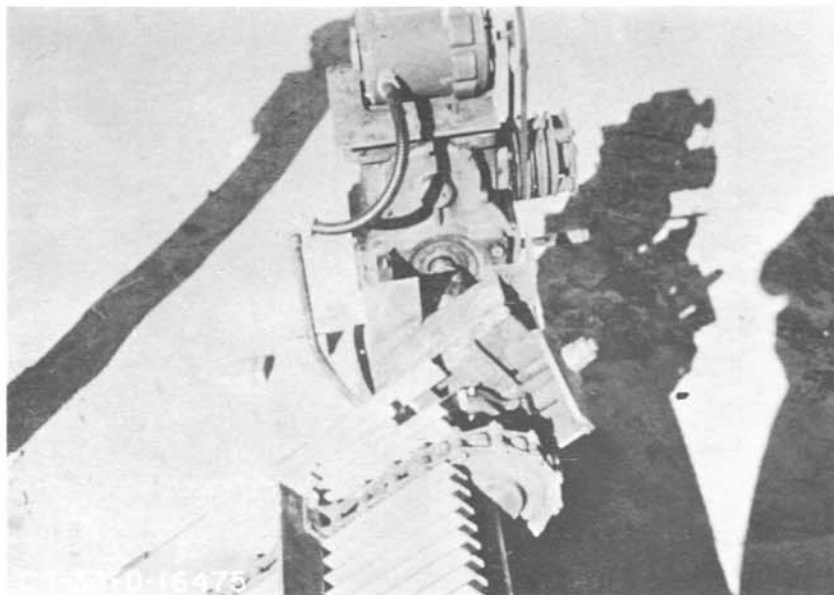
AMON SIPHON INLET TRANSITION-TRASHRACK
AND CHECK STRUCTURE..... 566-D-686

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION YAKIMA PROJECT KENNEWICK DIVISION-WASHINGTON MAIN CANAL STA. 1301+27.30 TO STA 1322+ 61.31 AMON SIPHON TRASHRACK-SEAT AND SUPPORT	
DRAWN L.L.F.	SUBMITTED C.W. Bennett
TRACED	RECOMMENDED J.S. [Signature]
CHECKED K.V. [Signature]	APPROVED J.S. [Signature]
DENVER, COLORADO	NOV. 16, 1934
566-D-718	

construction. The rack was installed on a 1:1 slope and had one-inch clear openings between longitudinal bars which were supported by cross members at 4-inch centers. It was difficult and time consuming to prevent obstruction of the trashrack by weeds, moss, and debris. The close spacing of the longitudinal bars of the rack probably contributed to the problem, though the rack is necessary if the trash, etc., are to be kept from the pumps.

To overcome the problem, the irrigation district installed the electrically powered angle-iron drags, attached to endless link chains. These were operated from sprocket-driven pulleys on both sides of the rack. To date, the device has proved very satisfactory in removing weeds and debris from the rack and with additional modification proposed, will be even more efficient in operation.

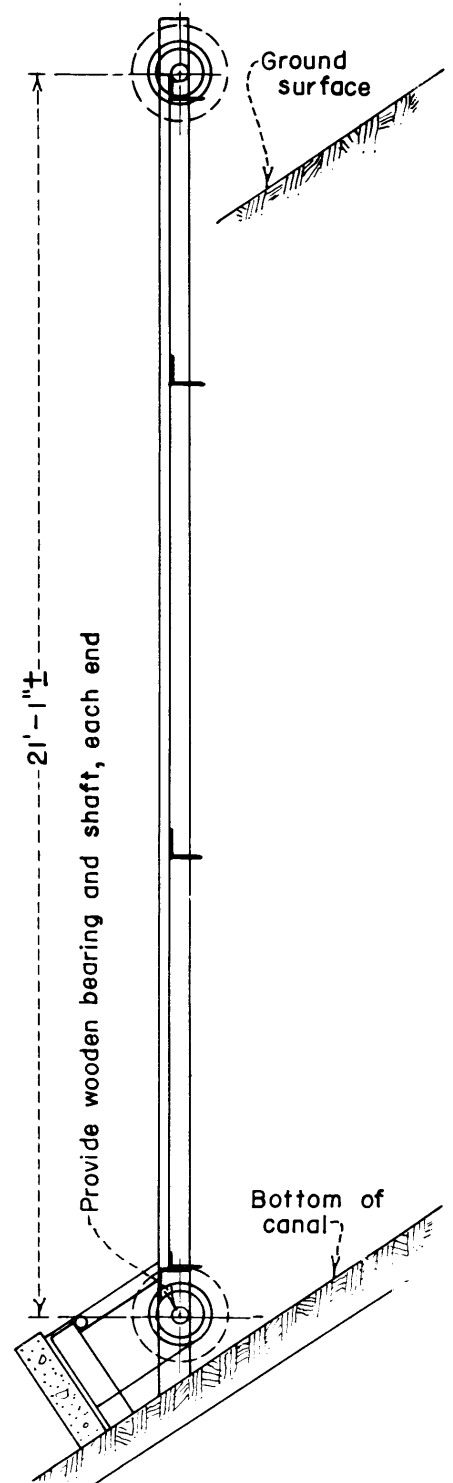
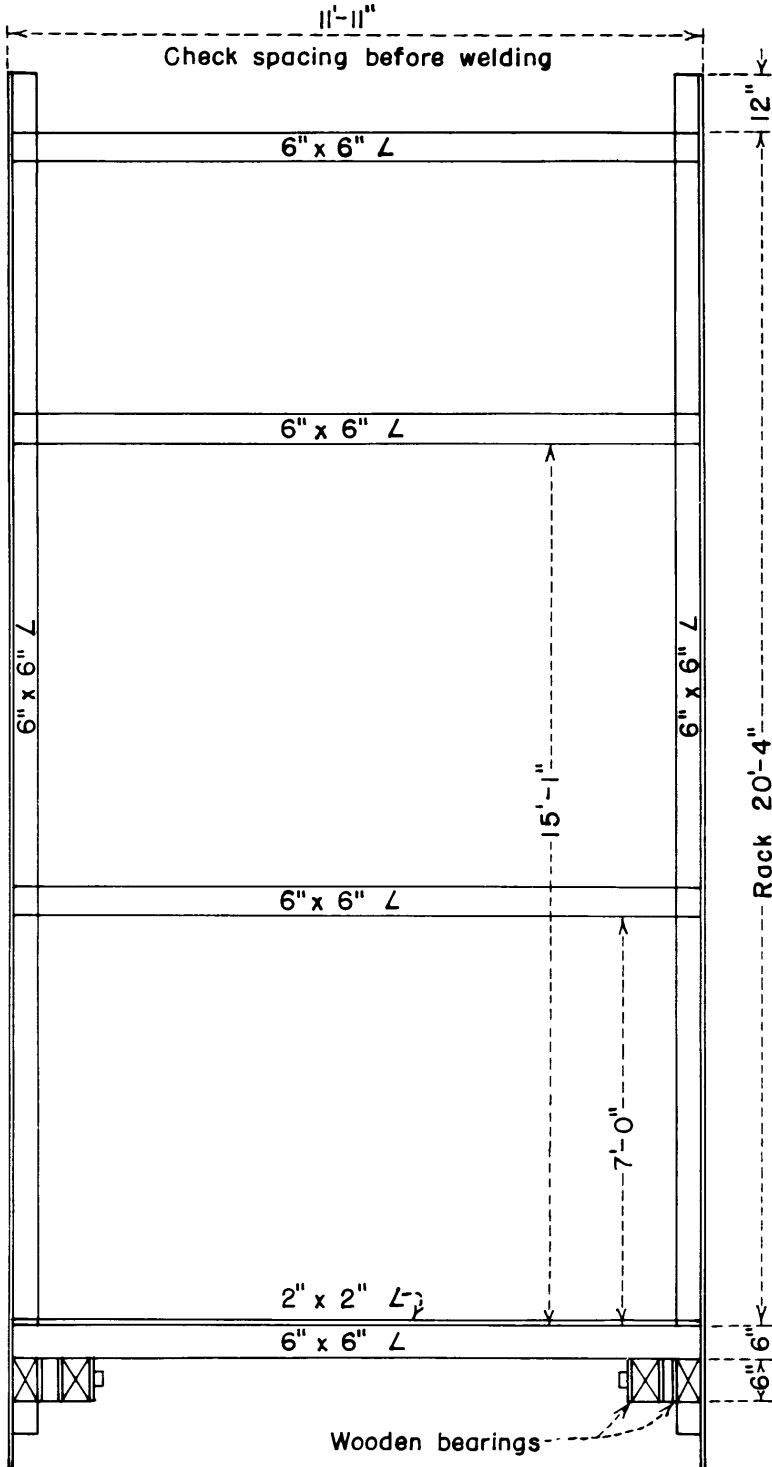
Many of the ideas incorporated in the Amon siphon rack cleaning device were taken from a similar installation made to protect and clean a trashrack at the Grandview Irrigation District pumping plant on the Yakima Project. Mr. Oscar Hanby, an operator at the Chandler Power Plant, built the Grandview device. The Amon installation, as shown in the sketch on the following page, consists of a rigid steel frame supporting a lengthened standard Bureau trashrack, which is cleaned by $3\frac{1}{2}$ - by $3\frac{1}{2}$ -inch angles connected on each end to moving chains. The cleaning angles move about 5 feet per minute.

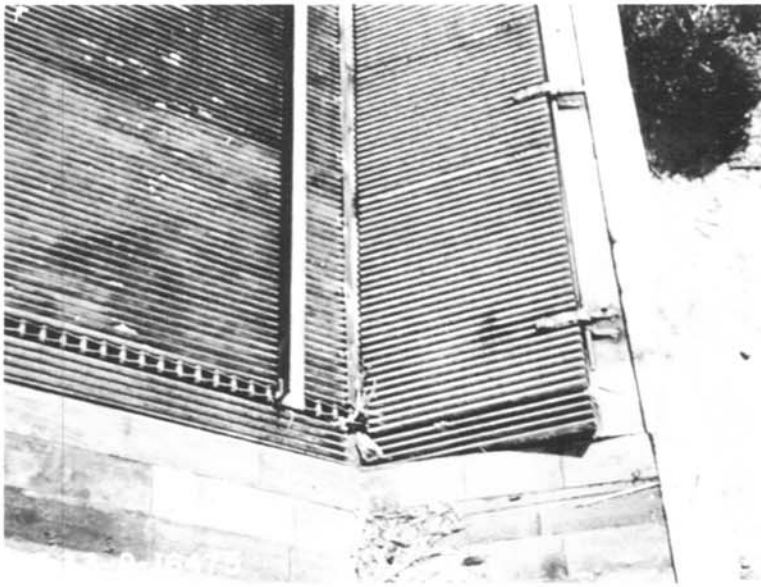


As shown in the photograph above, a 1/4-hp motor provides the power through a stoker gear box and a 1-3/4-inch steel shaft at the top of the rack. The upper bearings are connected to the frame in such a manner that they are adjustable to allow taking slack out of the chain.

BILL OF MATERIAL

Single Phase electric motor $\frac{1}{2}$ HP	4" x 4" L	12' - 0"	five
Gear box	Weed rack	12' x 5'	one
$1\frac{3}{4}$ " shaft	Weed rack	12' x 2'	one
$1\frac{3}{4}$ " shaft	10" Sprocket for $1\frac{3}{4}$ " shaft		four
6" x 6" L	$1\frac{3}{4}$ " bronze bearings		two
6" x 6" L	link chain		94'
2" x 2" L			





The lower sprockets are attached to the frame through hardwood bearings. These are highly recommended. At the canal bottom, a two-foot flap gate, shown at left, allows for passage of the cleaning angles. Prior to the installation of the device, the trashrack was remodeled so that the rack and cleaning device frame now rests on a $1\frac{1}{2}$:1 slope.

The automatic cleaning device can be improved according to Mr. Nutley and steps will be taken toward improvement as time permits. Suggested improvements include an extension of the trashrack at least 3 feet above the operating deck and possibly even a six-foot extension would be better. Sometimes, the flap gate which permits passage of the cleaning angles at the bottom of the canal becomes too heavy to be lifted when the screen is partially plugged with debris. This can occur particularly when the device has not been in operation for a period of time. Shortening the flap gate would improve this condition. It is also believed the spacing between the cleaning angles should not be more than five feet.

In summing up his discussion of the subject, Mr. Nutley stated, "The question is, of course, does it work? We believe that we saved the \$2,100 cost of remodeling the structure the first year. It does a fine job of cleaning algae and floating moss and one night in four hours, during and after an 85-mile wind, we took enough tumble weeds from this trashrack to make a pile 20 feet wide, 12 feet high, and 100 feet long."

* * * * *

UNDERWATER INSPECTION SCOPE (Suggestion R1-57-111)

The irrigation feeder canal on the Columbia Basin Project, Washington, carries water from the pumping plant headworks to the balancing reservoir and is full of water much of the year. The section below the radial gates cannot safely be drained without lowering the reservoir; in avoiding damage to the concrete lining which would result from hydrostatic head behind the lining, the section above the gates can only be emptied very slowly.

Experience with the canal has shown that occasional inspections are desirable, and much of this must be done with water in it. To avoid

the necessity of employing divers, Howard D. Thomas, Engineer in the Power Field Division, with headquarters at Coulee Dam, Washington, designed a unique hydroscope which can be used from a small boat, but gives the inspector the advantage of seeing the bottom as it appears from the lower end of the hydroscope; that is, only three or four feet distant.

A shop drawing of the hydroscope is given on the preceding page. Briefly, the hydroscope consists of a 4-inch diameter aluminum pipe about 15 feet long with a lens system at each end equivalent to that of an ordinary telescope, but with the two arranged to face each other. This has the effect of moving the eye point the length of the tube, but results in no magnification. The field of view is 53 degrees so that a circle 4 feet in diameter can be seen at a distance of 4 feet.

The hydroscope weighs 80 pounds and is arranged to float vertically with the upper end two feet out of the water. On a normally bright day, no additional illumination is needed in water 20 to 25 feet in depth. With lights attached to the hydroscope, a clear view is possible at all times. Additional sections of pipe can be added in the middle section to adapt the device to deeper water.

Cost of constructing the hydroscope was about \$325. The amount saved would be the difference between the cost of employing a diver for inspections and the cost of handling the equipment. One advantage is that the hydroscope is immediately available for use whenever any trouble is suspected, while a diver usually cannot be obtained for several days. Another advantage is that when a diver is used, he will often roil the water and impede the view by walking in the silt and mud found in the bottom of a canal.

Since the drawing gives no information on the lens system used, it should be noted that the eyepiece has a $1\frac{1}{4}$ -inch focal length and is 54 millimeters in diameter. The telescope objective lens is a cemented achromatic 1016 millimeters (40-inch) in focal length, 83 millimeters in diameter, magnesium fluoride coated. Variations can be used if the scope dimensions are changed.

As stated previously, visibility is increased by the addition of artificial light. In deep water the addition of a floodlight mounted near the lower end will supplement natural illumination. If further information is desired, write the Project Manager, Columbia Basin Project, U. S. Bureau of Reclamation, Ephrata, Washington.

* * * * *

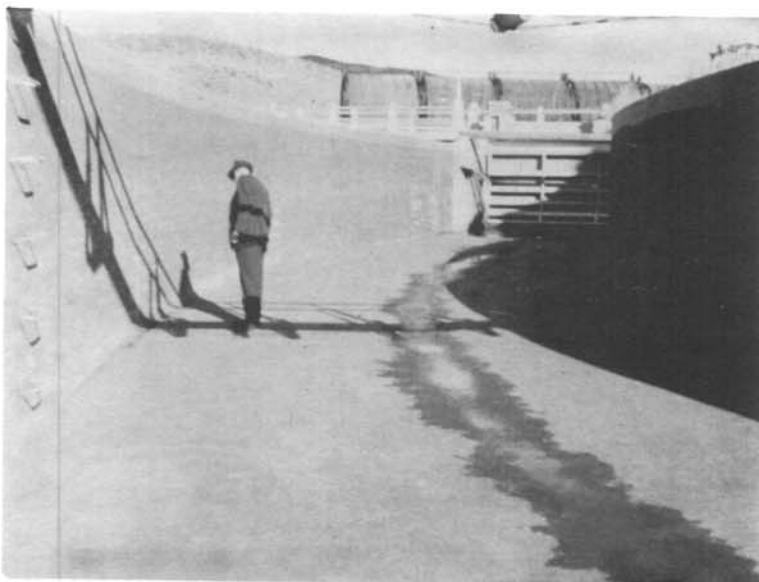
CONTROL OF ALGAE AND BLACK FLY ATTACHMENT TO CONCRETE FLUMES

Release No. 6 of the bulletin for September-October 1953 reported problems encountered with algae and naiad cocoons on concrete flumes of the Black Canyon Canal, Payette Division, Boise Project, Idaho. The problem continues to be a very troublesome one in that the carrying capacity of the flumes is seriously reduced because of the attachment of algae and cocoons to the sides and bottom surfaces of the flumes.

Several surface coatings have been applied to the concrete surfaces over the years to reduce the attachment of the foreign adherents; among these are CTP-3 paint, catalytically-blown asphalt, and more recently an antifouling paint. In addition to the paints and coatings of asphalt, chemicals which inhibit or retard the growth of algae were mixed with CTP-3 paint, and again more recently, a roof has been placed over a short reach of one flume to determine the effect sunlight has on the algae.

In commenting on the more recent attempts at control of both algae and concoc attachment, Mr. John Walker, Manager, Black Canyon Irrigation District, who is responsible for the operation and maintenance of the project facilities, states that covering the flumes will not control the black-fly activity and that the cocoons do appear in tunnels and siphons. The infestation is usually heavier on rough surfaces. Turbulence or high velocity of water flowing in the flumes and tunnels reduces the problem.

The antifouling paint seems to inhibit the growth of the black-fly cocoons to some extent, but whether this is because of the characteristics of the paint or smoothness of the surface has not been established by trials. The heaviest infestation this past year has been in a tunnel 9 miles from the head of the canal.



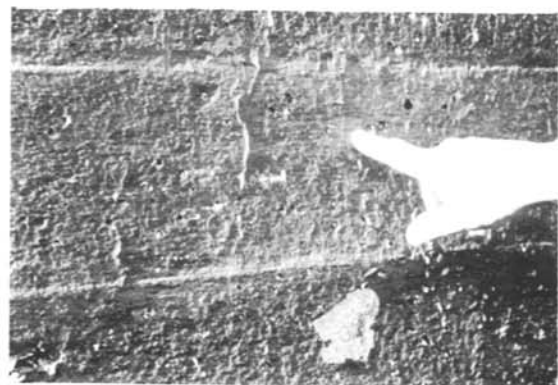
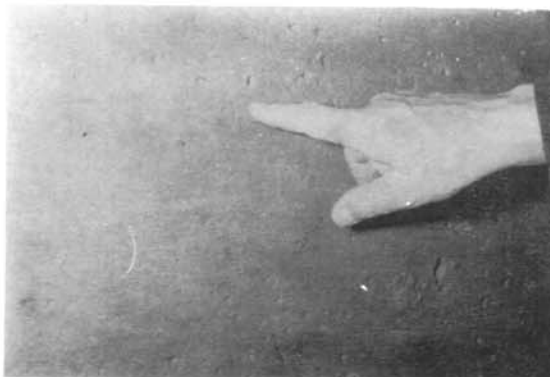
The antifouling paint applied to the bench flumes has given generally good results. The first flume immediately below the point of diversion, Station 0+00 to 6+30, is in fairly good condition, as shown at left, and the coating is expected to last through another year, the third irrigation season since application. The second flume, Station 86+52 to 102+00, will have to be

repainted again this spring. More difficulty is encountered in keeping this second flume in condition. The antifouling paint has only served for two irrigation seasons and it is contemplated that it will be painted prior to the beginning of the irrigation season with the antifouling paint at the rate of 1 gallon per 200 square feet.



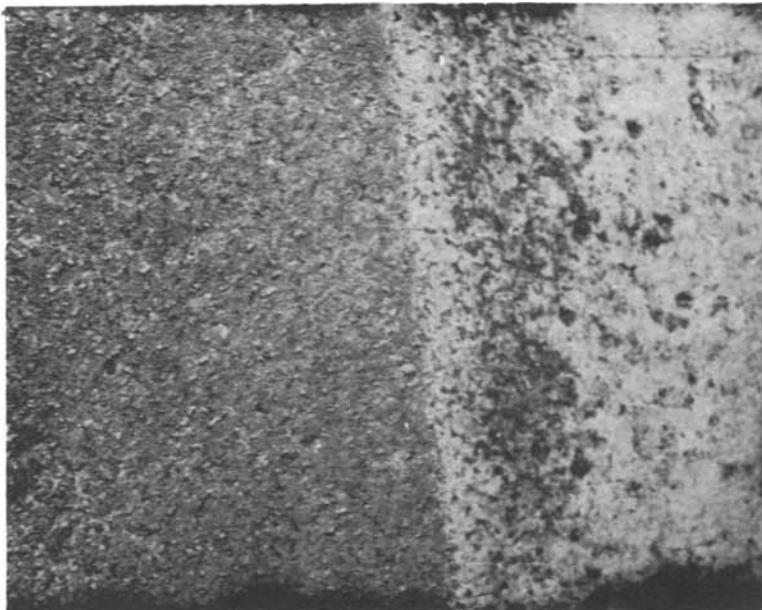
Covering the flumes with a shed roof definitely has advantages. The antifouling paint in the shade of the roof, as shown at left, is in much better condition than that exposed to the direct sunlight as shown in the photograph on the preceding page. An estimate of the annual cost of maintenance with the shed roof is close to that for more frequent painting.

It is estimated that the annual cost of painting is now \$1.08 per linear foot of flume. The cost of the shed-type structure to cover the flume is estimated to cost \$20.00 per linear foot. Some painting would have to be done under the sheds at about 6 to 7 year intervals. Interest on the investment would have to be added to the cost as well as the cost of maintenance. A distinct advantage, however, and an important one, is that the shed could be constructed during the winter and it would not be necessary to clean and paint the flumes during the rush period just before the start of the water season, when weather suitable for the painting operation permits.



In the photographs above, the condition of the paint with and without the protection of the shed are illustrated. The smooth, adhering paint under the shed in the left photograph, that has been in service two irrigation seasons, is in sharp contrast to the scaling, peeling

and deteriorating surface shown at right that has been in service for a similar length of time, but exposed to the sunlight.



The photograph at left shows the black-fly cocoons adhering to the concrete at the inlet to a siphon, although the concrete surfaces were treated with the antifouling paint.

Preparations for repainting must include the removal of adhering algae and cocoons as well as loose deteriorated concrete and other foreign matter.

* * * * *

ALUMINUM MARKERS FOR TRANSMISSION TOWERS (Suggestion R2-57-116)



As a result of a suggestion of Electrical Engineer William Eckhoff, that aluminum decals be used in the marking of transmission line towers, automotive equipment and other property, the Bureau's Regional Office in Sacramento, California, decided to try the idea for a year in the marking of identification letters and numbers on transmission line towers, as shown at left.

Regional Supervisor of Irrigation and Power Martin Blote, has announced that the tests have proved the markers satisfactory and that this method of marking is now being used region-wide at a savings of some \$1,500 per year over the previous practice of stencilling the identifying letters and numbers.

Further information on the use of the markers can be obtained by

writing the Regional Director, U. S. Bureau of Reclamation, Sacramento, California.

* * * * *

SPREADER BOX ON DOZER BLADE (Suggestion R2-57-9)

A spreader box mounted on the dozer blade of a tractor was constructed to spread roadway base material on the canal bank operating roads of the Lindsay Unit, Fresno Operations Field Branch, Central Valley Project, California. The box provided a uniform spread depth and width of material end dumped on the roadway from trucks, and was a joint suggestion of T. R. Meyer, Canal Superintendent, and Equipment Operators Lee Goodson, and J. B. McPhetridge.



With reference to the above photographs, the side panel of the spreader box was constructed of 3/8-inch plate steel about 24 by 30 inches in size and further cut to fit and welded to the dozer blade with a spread width of 10 feet. The side panels were later lengthened to about 4 feet to better carry the material in the spreading operation. (The top of the side panels had not been cut off at the time the photograph was taken.) The panels were braced with 3/8-inch by 2-inch strap iron, extending from the midpoint of the panel to the dozer blade.

Shoes were welded to the outside of the side panels with the bottom of the shoe flush with the bottom of the side panel 4-1/4 inches below the dozer blade. The shoe cut into the roadway surface about 1/4 inch giving a finished spread depth of material of about 4 inches and a sharp shoulder to the surfaced roadway.

Many improvements could be made in the box, according to the project employees responsible for the idea and its fabrication. A heavier steel angle, say 3/8-inch by 2-inch by 2-inch, at the top and bottom of the panel would have been more satisfactory in preventing the box from warping out of position when spreading around curves. Shoes of different depth could be provided for spreading thinner or thicker layers

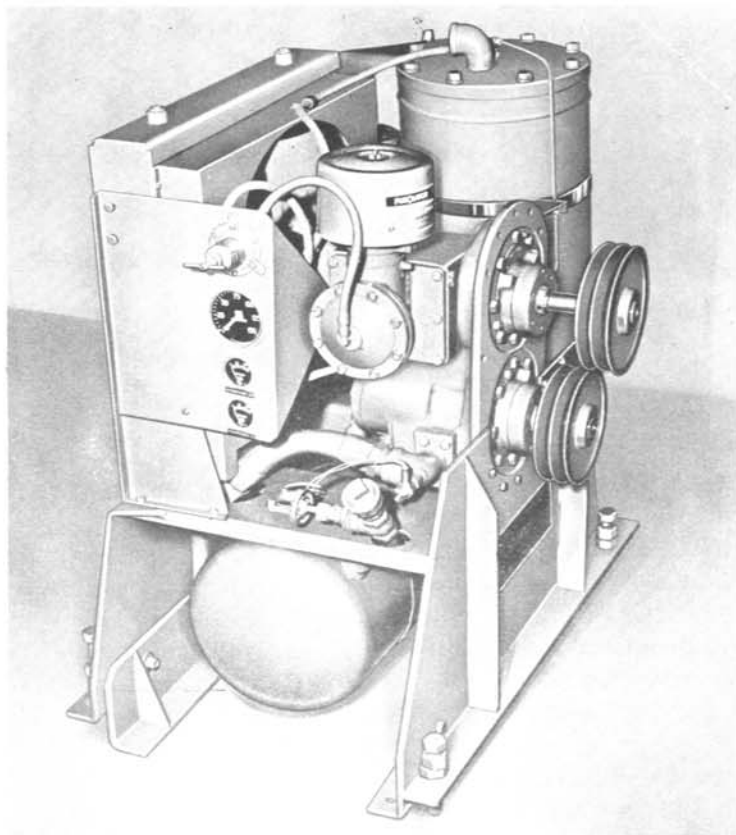
of material. Constructed of scrap material by O&M forces in 4 hours of welding time, the idea saved in equipment operation and did a very satisfactory job in meeting a maintenance need.

The method of spreading speeded up the truck haul, as the trucks were able to travel over the spread material, where otherwise the surface would not have been prepared for travel until all material had been spread.

* * * * *

NEW COMPRESSOR ADAPTED TO TRUCK MOUNTING

One of the leading manufacturers of air compressors has introduced a 125-cfm rotary model adapted to mounting in a maintenance truck with power for driving the compressor provided by the power take-off of the truck.



This could be a very convenient arrangement for maintenance crews needing considerable quantities of compressed air in their work, but who for one reason or another find it inconvenient to trail a conventional wheel-mounted compressor.

Utilizing the truck's power also results in a considerable saving in first cost as well as in equipment maintenance cost. An idea of the compactness of the unit may be obtained from the photograph at left.

The cost of the 125-cfm rotary compressor unit as shown is about \$2,700 in Denver, Colorado. The split shaft power takeoff to drive the unit is priced at about \$400. Further information on this piece of equipment may be obtained by writing the U. S. Bureau of Reclamation, Code 400, Denver Federal Center, Denver 25, Colorado.

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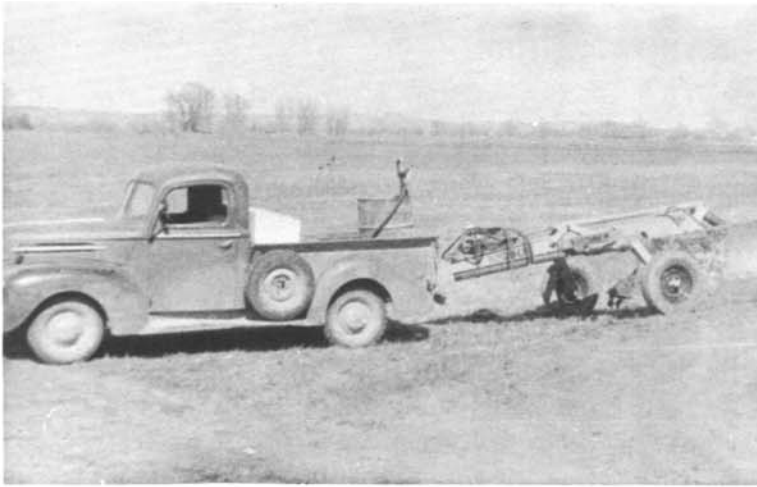
ONE-MAN DITCHER

Mr. Axel Persson, retired manager, Lower Yellowstone Project, Sidney, Montana, states that one big advantage of the ditcher shown below and on the following page is that it is coupled directly to the power unit and hydraulically operated, making the work accomplished with the ditcher a one man operation.



Commenting further on the piece of equipment, Mr. Persson states that there has been a need for improved mechanized maintenance equipment to increase the efficiency in maintenance on irrigation systems and at the same time reduce labor costs to a minimum. Due to the limited demand for certain types of maintenance equipment, manufacturers have been slow in developing this type of equipment; however, more recently, efficient and very useful equipment is now being developed. The ditcher described and shown here and bank slopers described in previous issues of the bulletin are comparatively recent equipment developments aimed at irrigation maintenance problems.

The ditcher has two hydraulic controls; one on the plow and one on the traveling gear. The dimensions of the ditcher are: 10.6-foot blade, 10-foot wing spread, and 30-inch depth of blade. The ditcher can be adjusted to clean any size ditch from 1 foot to 4 feet in depth, and can be raised to clear the average structure or ditch bank that the power unit can clear. The ditcher shown in this article and in use on the Lower Yellowstone Project, is mounted on a crawler tractor. With the quick break-away hose connections and hitch, the ditching unit can be dismantled in two minutes.



The mobility of the ditcher is shown in the photograph at left. Attached to the pick-up truck, it can be moved from place to place quickly and with a minimum of effort or lost time.

An example of the clean job performed by the piece of equipment is shown in the two lower photographs on this page.



Mr. Persson reports that the ditcher will cost approximately \$1,500 f.o.b. the factory, plus extras that may be required for attachment. This year the project was able to clean approximately 150 miles of ditch and surface drains at an average cost of \$8.00 per bank mile. The one-man operation is a saving in man power alone of more than the cost of the ditcher. Work performance is considered superior to any other ditchers the project has owned.



The ditcher is not carried in stock by the manufacturer, but will be made up on order in approximately 30 days. If further information is desired, write U. S. Bureau of Reclamation, Code 400,

Denver Federal Center, Denver 25, Colorado.

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CONCRETE BONDING AGENTS

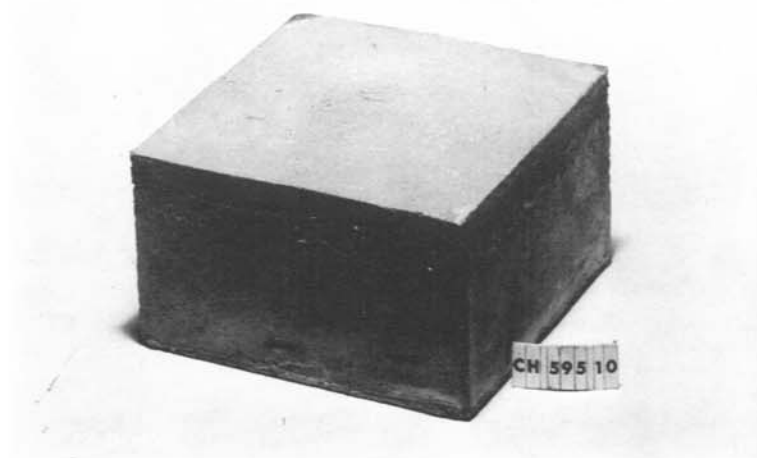
Tests preliminary to more exacting evaluation of concrete bonding agents have been conducted by the Engineering Laboratories of the Commissioner's Office, Denver, Bureau of Reclamation. From these preliminary tests some outstanding results have been obtained by using an epoxy-polysulfide bonding agent.

The tests included the bonding of fresh mortar to old concrete, bonding of old concrete to old concrete, and the patching of holes in concrete. Of the materials included in the tests, the epoxy-polysulfide bonding agent proved superior to other bonding agents and generally showed the bond to be stronger than the original concrete.

Bonding Fresh Mortar to Old Concrete



Two types of specimens were used in the tests, as shown at left, 6- by 12-inch cylinders and 3- by 3- by 1-1/2-inch mortar blocks. One half of the top surface of each cylinder was chipped; the other half was left as formed. The surfaces to be patched (capped) on all specimens were then etched with a 5 percent hydrochloric acid solution and rinsed.



Control specimens on which the patch was applied without a bonding agent were thoroughly dampened prior to application of the mortar. Specimens to be patched with the epoxy-polysulfide bonding agent were air-dried before application of the mortar patch.

The mortar for the patch was a 2:1 sand-cement dry-pack mixture. No. 30 sand was used in

the patches for the cylinders; No. 50 sand for the blocks. The patches were 1/4-inch thick.

The patched cylinders were left at room temperature overnight, then placed in a fog room for 4 days. The block specimens were placed in a fog room for 4 days immediately after initial set had taken place in the mortar patch. The specimens were air-dried for 1 day after removal from the fog room before being subjected to test.

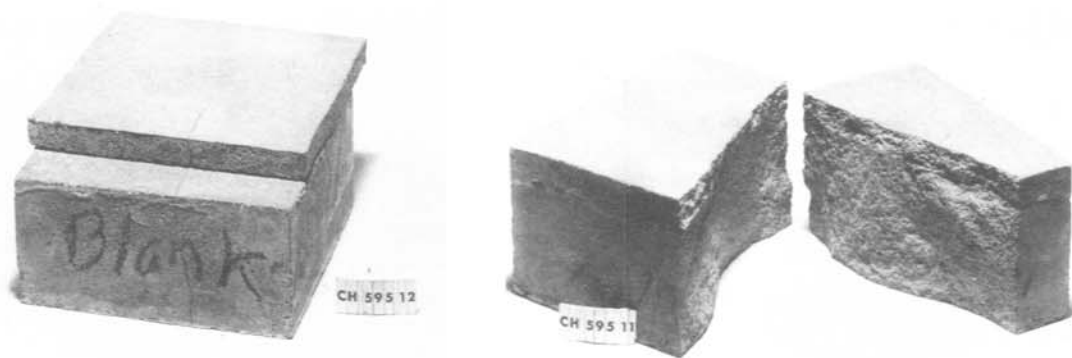
Impact tests, which are often used to evaluate the adhesion of one material to another, were used in these preliminary evaluation studies. The force of an impact blow causes disbonding proportional to the adhesion when such factors as elasticity, flexibility, structure of the joining materials, etc., are considered. When similar topping layers are compared, a correlation between impact resistance and adhesion exists. For the test, a 600-gram steel ball was dropped onto the patch. The ball was dropped from a height of 8 feet above the base of the specimen. Distance of travel to the cylinder patches, therefore, was 6 feet 11-3/4 inches, and 7 feet 10-1/2-inches for the cylinders and blocks, respectively. The cylinders were struck in two places; one on the patch over the chipped base area and one on the unchipped base, each blow about 1-1/4 inches from the edge of the cylinder. The block specimens were struck near the center of the patch.



The control or blank specimen, fabricated by applying mortar directly to the surface to be patched without a bonding agent, as stated previously is shown at left. A segment of the patch was broken and disbonded upon each impact of the steel ball on the cylinder patch. The patch to the cylinder after the epoxy-polysulfide bonding agent had been applied as a brush coat to the surface is shown in the upper photograph on

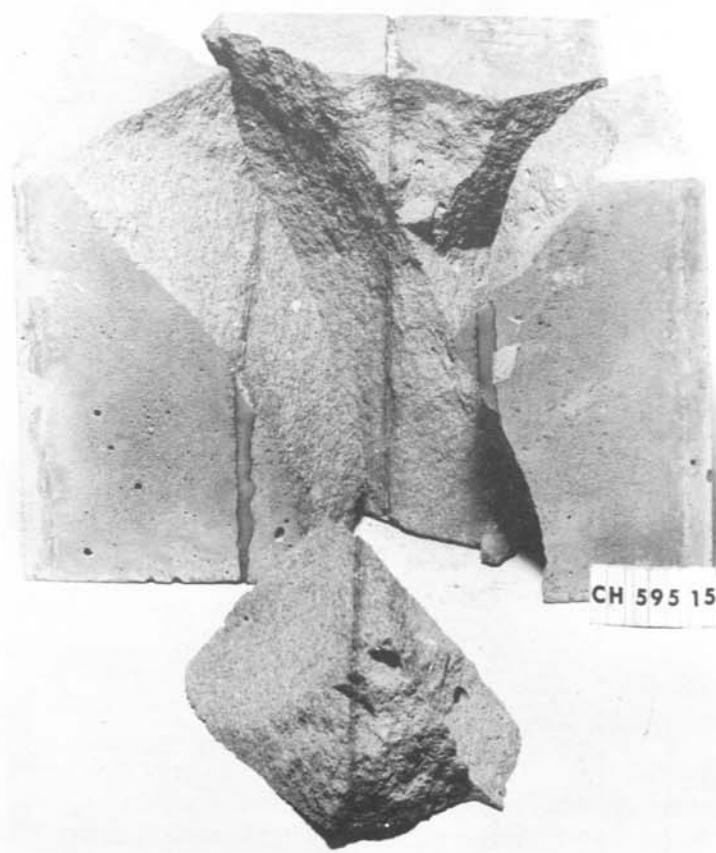
the preceding page. No apparent damage was evident after impact on the specimen and the points of impact can be clearly seen as depressions in the patch.

The patch applied to the control or blank block specimen is shown in the photograph at left on the following page. The patch was completely disbonded from the specimen on impact and it will be noted that a crack extends through the patch and block. The photograph at right, also on the following page, shows the result of impact on the block specimen the surface of which was treated with the bonding agent



prior to placement of the patch. The specimen broke cleanly through the patch and block. There was no evidence of disbonding in the adhesive layer or in the patch.

Bonding Old Concrete to Old Concrete

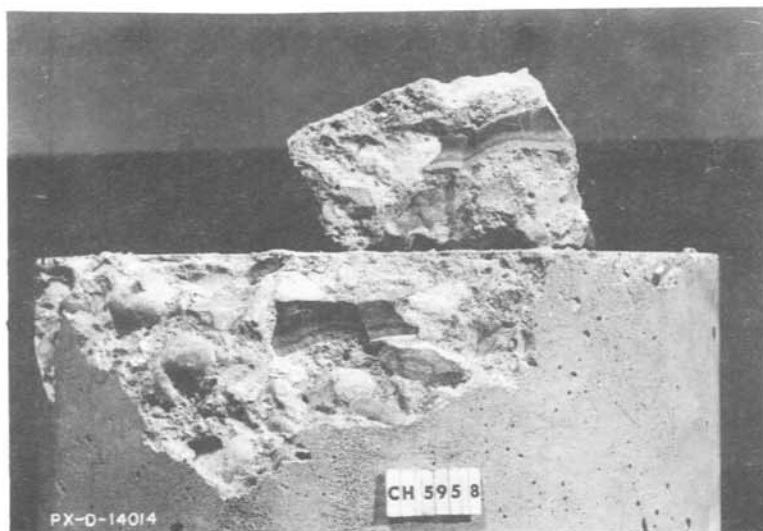


To obtain some idea on how the epoxy-polysulfide would perform as a bonding agent between old concrete and old concrete, two 3- by 3- by 1-1/2-inch blocks were cemented together, cured, and then tested under impact. The surfaces of the two blocks were cleaned, etched, rinsed, and then dried. The bonding agent was brush-applied lightly to each of the surfaces to be joined, again following recommended procedures. The blocks were then placed together and left at room temperature to cure. No pressure was applied to the joint during curing. After 6 days, the impact test was made, with the point of impact being on the joint.

The photograph above shows the result of three impact blows on the joint. No loss of adhesion is evident. The break in the specimen is as if a single solid block were broken.

Concrete Patching

A brief test was made on a catalyzed epoxy resin patching material that had been made available. The material, which contains an inert filler, was applied to a hole chipped in the top of a cylinder specimen and as an edge patch to a chipped edge. After curing, the impact tests were run.



Results of the impact tests are shown in the photographs at left. No apparent damage is evident in the center patch. The concrete base of the edge patch broke rather than the patch after three impact blows. At the left edge is a break in the concrete edge caused by one impact blow on the original concrete to the specimen. Regular impacts on these materials will be made on specimens similar to the mortar patches, rather than on a restrained patch.

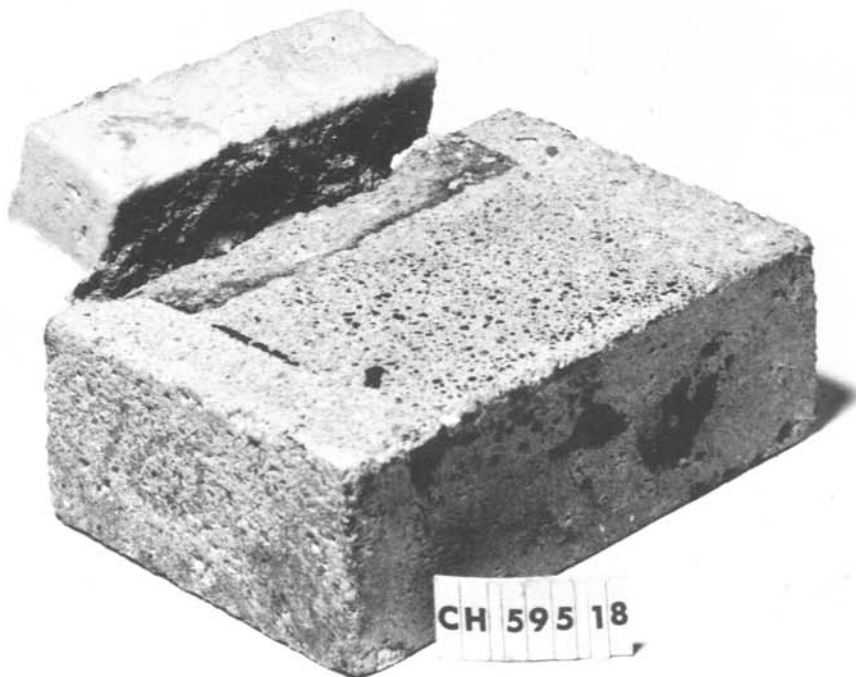
The lower photograph shows the broken concrete base of the edge patch shown in the upper photograph at the right side.

The photograph on the following page shows part of a specimen fabricated for extension tests and shows the break in the mortar block rather than at the interface or within

the resin mass when the specimen was broken. The material is the same catalyzed epoxy resin compound used in the above cylinder patching tests.

Additional studies on the epoxy-polysulfide bonding agent, the epoxy patching materials, and other materials for use as bonding agents and patching materials are being continued in the laboratories. The studies will include tests made after alternate wetting and drying, after

freezing and thawing, and after normal aging. The more exacting evaluation of those compounds and materials which show promise in impact screening tests will be by shear bond tests similar to but smaller than those used by Mr. Earl J. Felt, reported under "Resurfacing and Patching Concrete Pavement with Bonded Concrete," Highway Research Board Proceedings, Volume 35, page 444, 1956.



Field Applications

On the basis of the tests made to date, and since other laboratory data are not available yet on a variety of compounds, the Bureau's Laboratory has suggested the epoxy materials be used in limited applications for concrete repairs in the field. The bonding agents are relatively expensive at present, one gallon of the material costing about \$20. That is enough material to treat about 250 square feet of surface area. The filled patching materials of course are used at lesser rates depending on the thickness of the patch to be applied.

It is suggested that all proposed trial applications be approved by this office. Certain procedures and precautions must be followed in the use of these materials. Proper handling is necessary to avoid hazards to the health and wellbeing of personnel that come in contact with them. Sources of the materials and proper handling directions can

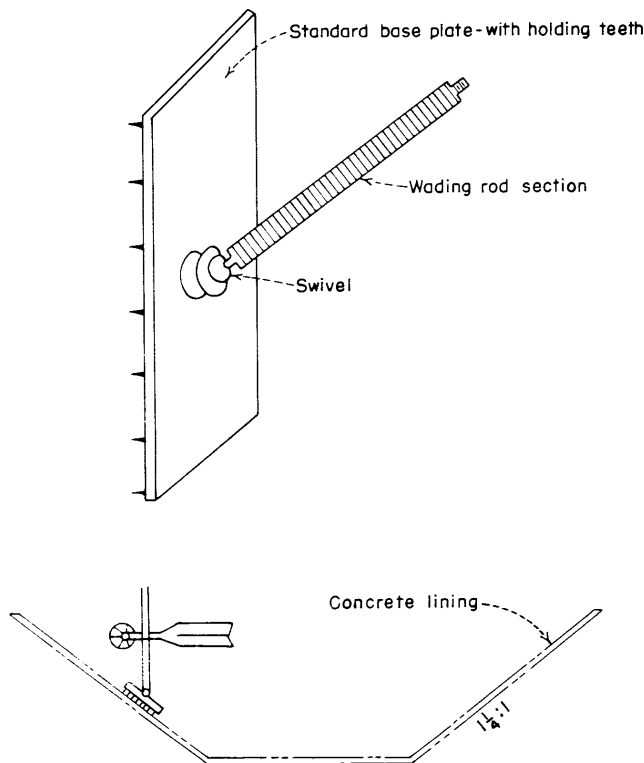
be obtained by writing the Commissioner's Office, U. S. Bureau of Reclamation, Denver Federal Center, Denver 25, Colorado.

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BASE PLATE FOR CURRENT METER ROD (Suggestion R2-59-160)

A steel toothed, swiveled, current meter base plate for making wading rod current meter measurements in the sloped concrete-lined canals is being used on the Contra-Costa Canal System of the Central Valley Project, California. The device is a suggestion of Donald J. Berry, Supervisory Engineering Technician, of the Tracy Operations Field Branch.

Considerable difficulty has been experienced in the past during current meter measurements of small flows by the wading rod method in small, lined canals. The difficulty arose when the straight rod was placed on the side slope of the canal and held in a vertical position. The rod was susceptible to sliding down the steep, relatively smooth slope, thereby causing erroneous readings of current and depth at a particular station or interval being measured.



The device consists of case hardened steel teeth on the bottom of a metal base plate as shown in the sketch above and aids materially in holding the rod steady on the sloping concrete. A swivel permits positioning of the wading rod and current meter in a vertical position. Holding the meter properly allows the hub bearing to turn freely on the pin.

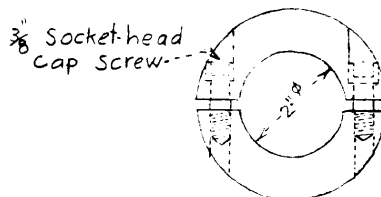
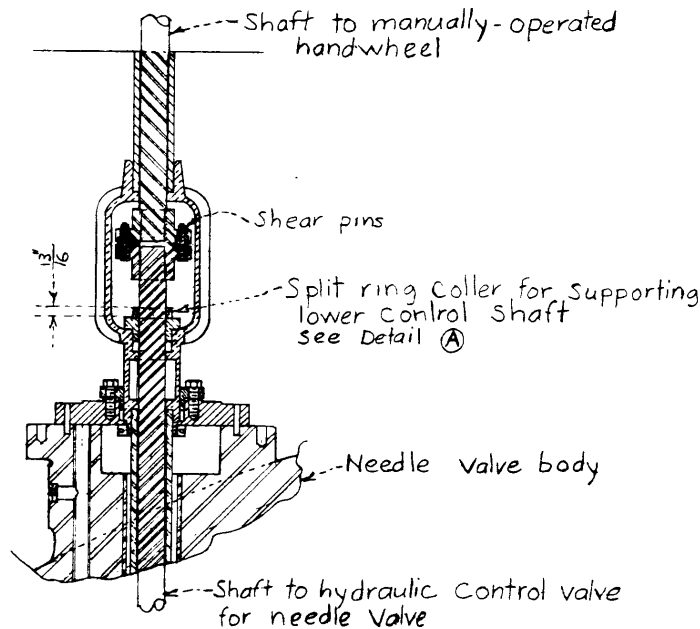
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SPLIT-RING COLLAR SUPPORTS OPERATING SHAFT (Suggestion R3BC-58-133)

Outlet works at Hoover Dam, located on the Colorado River and a part of the Boulder Canyon Project, include eleven 84-inch and twelve 72-inch needle valves which are hydraulically operated by use of water at penstock pressure. The control stands are located on a floor above the needle valves and the 4-way piston type control valves are located under the needle valves. Shafting passing completely through the needle valves is used for connecting the control stands to the 4-way control valves.

The bearing that supports the lower section of the control shaft is inside the 4-way control valve. Consequently, this section of the control shaft must be supported from above before the control valve can be dismantled. Because of the corrosive action of the Colorado River Water, the piston-type valves must be dismantled and cleaned annually. Cleaning operations include removing the loose rust and scale

which is deposited in the water passageways and removing a lime coating which collects on the machined surfaces.



HOOVER DAM
SUPPORT FOR CONTROL SHAFT
ON NEEDLE VALVES

A device that has been permanently installed on each of the large needle valves at the Hoover Powerplant and which has been very satisfactory is a split-ring collar shown in the sketch at left. Support for the lower shaft in the manner indicated was a suggestion of Houston I. Wheeler, Powerplant Mechanic, who headquarters at Boulder City, Nevada.

People responsible for maintaining needle valves of the type described on other Bureau works have probably encountered similar problems and can depend upon the suggested device

supporting the weight of the lower operating shafts.

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CLEARING FLOATING LOGS FROM RESERVOIRS

Winter storms bring a huge pile of logs and other debris into Shasta Lake, the 4,493,000 acre-foot reservoir created by Shasta Dam on the Sacramento River in northern California, and an integral part of the Central Valley Project. The logs are a threat to navigation and a menace to life and must be cleared away. Clearing is done by "snaking" the logs by boat to shore where they are fastened to trees or other logs so fastened, and where they can be burned when the water level in the reservoir is lowered.

Faced with the big operation involved in clearing the logs from the lake, Marine Foreman W. Evert Rice, Tugboat Operator Arthur M. Parks, and Motor Boat Operator Meral A. Elliott, began devising a means to do the work faster, easier, and in a less expensive manner. They devised a hinged platform that enabled them to work at water level from the boat while tying the logs together; a drum to hold scraps of wire used for tying the logs together; and a jig for making eye bolts from big spikes that are driven into the logs and through which wire is threaded for the towing operation.

Water Level Working Platform



The working platform shown in the photograph at left swings over the side of the boat and provides a platform on which a crew member can stand while driving bolts or spikes into the logs for towing to shore, either one at a time or several fastened together. Without the platform, the whole operation would be extremely difficult and hazardous, because one could not reach the logs and drive the bolts from deck level.

Eye Bolt Jig

Eye bolts of the size necessary cost 25 cents or more each. By devising a jig from pipe and by clipping the heads off spikes

with a bolt cutter, the spikes can be used instead of eye bolts, at a cost of only about 4 cents each, which includes the cost of labor for bending and cutting. The jig for bending the spikes and one of the finished spikes are shown in the photographs below.



In addition to the saving in the cost of material, there was an additional saving of time in the use of the pointed spikes which were easier to drive into the logs. The U-shaped open end formed in the spike made it possible to drive the spike into a log part way, and a tie line, which may be holding several logs together, can then be snapped under the hook end of the spike before driving it completely into the log over the wire. With a closed eye-bolt, the end of the long towing line would have had to have been threaded through the opening in the eye-bolt.

Cable Drum for Holding Wire Scraps

Various kinds of scrap wire is used for tying the logs together--old telephone wire, power line wire, fence wire, etc. There had to be some device for holding and dispensing such scrap wire and the cable drum made from scrap and shown on top of the boat cabin was fabricated by the resourceful employees.

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